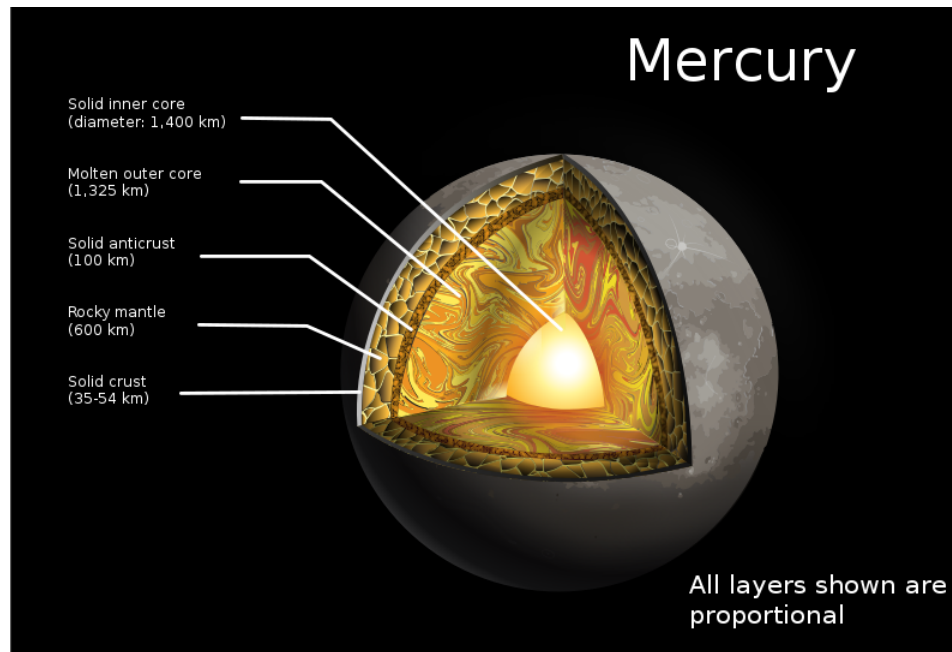


10.1: Mercury and Venus

As the inner most planets, the orbits of Venus and Mercury show that these planets never appear far from the Sun. Venus has been known as both the Morning Star and the Dawn Star as it appears either just after sunset or right before sunrise.

10.1.1 Mercury



Mercury and its interior.

[https://commons.wikimedia.org/wiki/File:Mercury_\(planet\).svg](https://commons.wikimedia.org/wiki/File:Mercury_(planet).svg)

Because of its closeness to the Sun, Mercury can be difficult to image from Earth. In fact, Mercury orbits so close to the Sun that the Hubble Space Telescope might damage its optics if it attempted to photograph it.

Instead, its rotation rate had to be measured using radar from Earth. Because of difficulty in measuring its rotation, astronomers had long thought that Mercury was tidally locked to the Sun. Just as the same side of the Moon always faces the Earth, astronomers believed that the same side of Mercury always faced the Sun. However, radar measurements in 1965 showed this to be false.

Instead, Mercury's day and year are in a 3:2 resonance. In other words, Mercury rotates on its axis three times for every two orbits it makes around the Sun. Its rotational period is 59 Earth days while its orbital period is 88 Earth days. Because it lacks a substantial atmosphere, Mercury does not retain the Sun's heat during its nighttime period. This gives Mercury the most extreme differences in temperature. Temperatures reach about 700 K during Mercury's day and plunge down to 100 K during its night.

Of all the planets, Mercury has the greatest inclination. Its orbit is tilted 7° to the ecliptic. Its orbit is also very elliptical, with an eccentricity of 0.21.

Mercury is also the most metallic of the planets, being 70% metallic and only 30% silicate.

The dimensions of Mercury are given as follows:

- Mean Radius: 2,440 km or 0.3829 Earths
- Density: 5.427 grams/cubic centimeter
- Surface Gravity: 0.38 Earths
- Atmosphere: none detectable
- Atmospheric Pressure: trace
- Surface Temperature: 100-700 K
- Magnetic field: yes
- Moons: None

Because of the difficulty in reaching Mercury, the MESSENGER mission in the early 21st century gave us the first complete mapping of the planet. MESSENGER showed us a world similar to the Moon, with numerous craters but fewer smooth maria compared to the Moon. Like the Moon, Mercury received numerous impacts during the Heavy Bombardment. One distinctive feature on Mercury is the **scarps** (cliffs), which are several hundred kilometers long and up to 3 km high. These cliffs are thought to be formed as the planet cooled and shrank, much like a hot glass container might crack if cold water is poured into it.

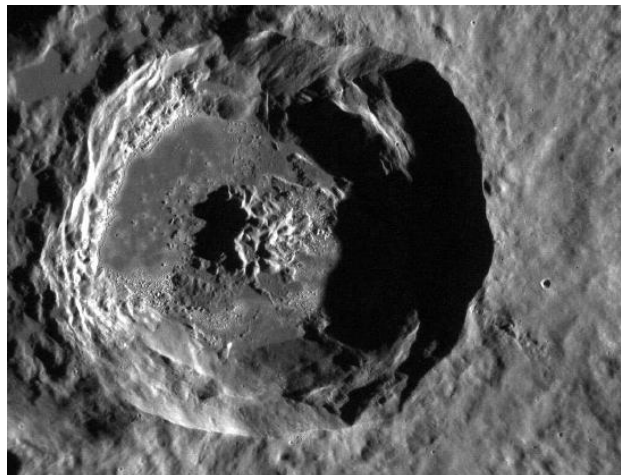
The most likely models for Mercury's interior suggest a metallic iron-nickel core amounting to 60% of the total mass and 75% of its radius, giving it the largest core relative to its size among the planets. The core has a diameter of 3500 kilometers and extends out to within 700 kilometers of the surface. The large core may be the result of a major impact, which tore away a lot of Mercury's original crust and mantle, leaving a planet that is mostly core.

Most of the Mercurian features have been named in honor of artists, writers, composers, and other contributors to the arts and humanities, in contrast with the scientists commemorated on the Moon. Among the named craters are Bach, Shakespeare, Tolstoy, Van Gogh, and Scott Joplin.

Today, Mercury appears to be a quiet world, with no evidence of current plate tectonics on Mercury. It likely lost most of its internal heat a long time ago due to its small size.

Mercury has no detectable atmosphere. Being so small, it lacked the gravity to hold onto many gases, especially given how close it is to the Sun. The high temperatures gave gas molecules the energy to escape the planet early in the Solar System's history. Without an atmosphere or plate tectonic, Mercury's surface is very old, probably as old as the Moon's surface.

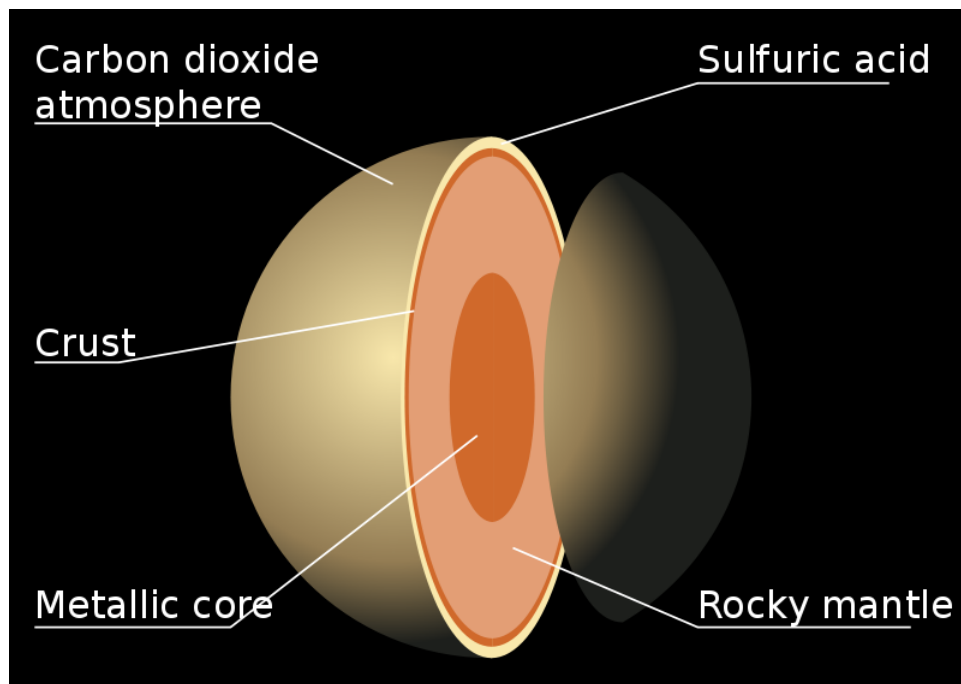
Despite being close to Sun, Mercury has polar craters whose floors are in permanent shadow. The MESSENGER probe has confirmed that these craters contain ice. As with similar craters on the Moon, asteroid or comet impacts probably delivered this ice to Mercury and the shaded craters have kept it frozen for billions of years.



Caloris Basin, a major crater on Mercury.

[https://www.flickr.com/photos/gsf/6323325370;](https://www.flickr.com/photos/gsf/6323325370)





Venus and its interior.

<https://commons.wikimedia.org/wiki/File:InteriorOfVenus.svg>

Like Mercury, Venus is a difficult world to observe from Earth. The phenomenon that makes Venus just a bright object in our sky also makes it impossible to see the surface in visible light. The cloud cover reflects so much of the Sun's light, keeping the surface hidden behind a permanent shroud. The thick atmosphere also traps so much heat that Venus has the highest surface temperature of all the planets with a uniform temperature of 735 K. The clouds are not water vapor, but sulfuric acid.

Because of its cloud cover and being closer to the Sun, science fiction writers often pictured Venus as a steamy, jungle world. Once we gain more information about its surface conditions, the picture changed dramatically. Instead of rainforests populated by prehistoric monsters, Venus is a barren, dry world where liquid water is impossible with temperatures hot enough to melt lead. The surface atmospheric pressure is 90 times that of Earth. At those crushing pressures, carbon dioxide behaves almost like a dense liquid. To make matters even more hellish, the clouds bring rains of sulfuric acid.

The rotational period of Venus is 243 Earth days and its orbital period is 225 Earth days. This means a day on Venus is longer than its year. Even more curious, Venus rotates retrograde, meaning the Sun rises in the West and sets in the East. The reasons for this slow rotation are unknown. Perhaps Venus experienced a collision that flipped it over and slowed its rotation down during the Heavy Bombardment.

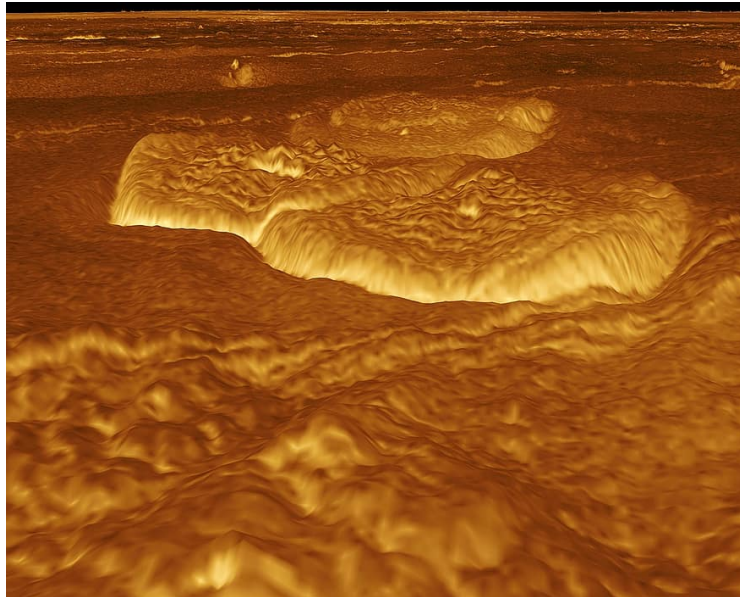
The physical characteristics of Venus are as follows:

- Eccentricity: 0.007
- Inclination: 3.4°
- Composition: Mostly silicates
- Mean Radius: 12,103.6 km (0.94 Earths)
- Density: 5.243 g/cm³
- Surface Gravity: 0.904 Earths
- Atmosphere: 96.5% Carbon dioxide, 3.5% Nitrogen
- Atmospheric Pressure: 90.8 atm
- Surface Temperature: 735 K (hotter than Mercury)
- Magnetic field: very weak
- Moons: None

In terms of size, density, and composition, Venus is much like the Earth, which is why it is sometimes referred to as Earth's twin. However, the atmospheres of the two planets could not be more different. While Earth's atmosphere is a mixture of nitrogen and

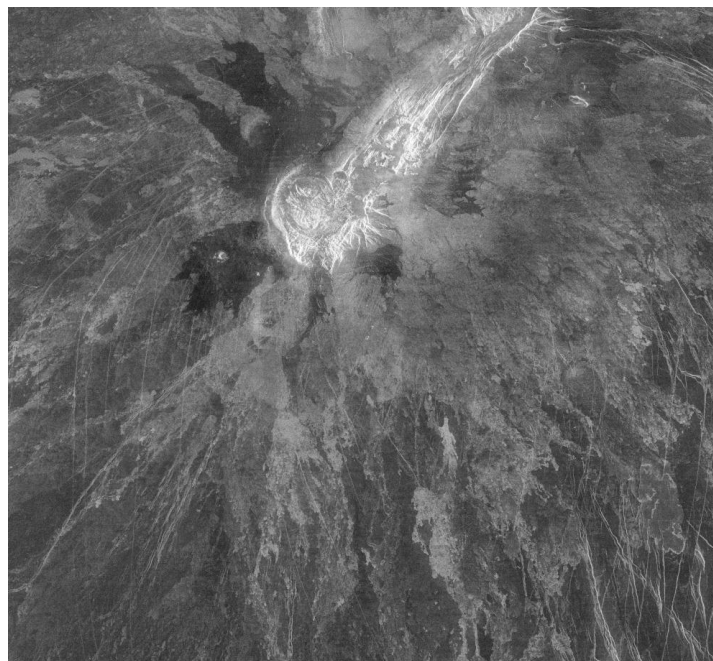
oxygen, Venus has an ultra-dense atmosphere mostly of carbon dioxide. This has given Venus a runaway greenhouse effect, trapping in nearly all the heat it receives from the Sun.

Venus has numerous **lava domes**, also known as pancake domes, on its surface. This were probably caused by magma flows that caused the surface to distend. When the magma retreated, the domes then collapsed. Venus also has areas of parallel ridges and troughs where the crust has been pulled apart.



Venus has several lava domes caused by magma flows that have since retreated.

<https://www.pikist.com/free-photo-xurmi;>



Gula Mons is a large volcano on Venus.

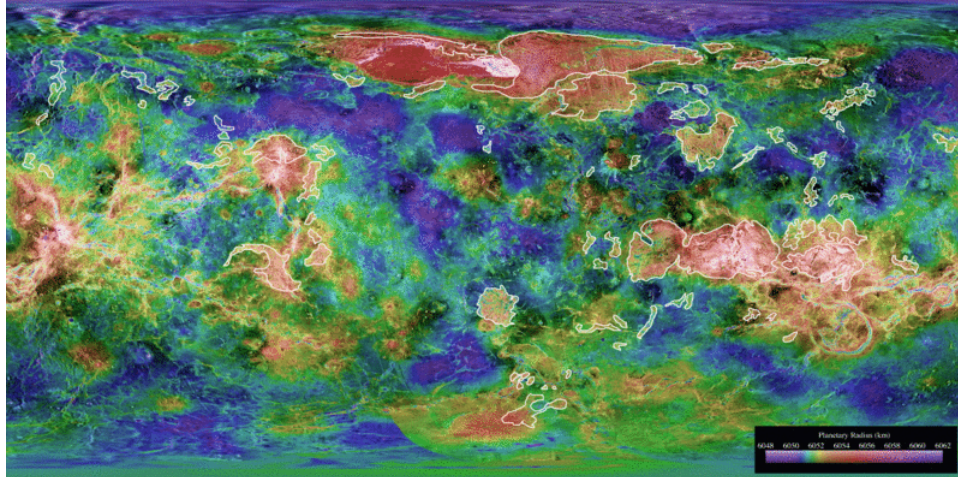
https://commons.wikimedia.org/wiki/File:Gula_Mons_plan_view,_779-,663,-116.jpg;

Scientists have identified other mysterious Venusian features such as “arachnoids” (Greek for spider), “anemones” and “ticks.” The formation of these distinctive patterns remains a mystery.

It is unclear if Venus has any active volcanoes. Some recent data indicates that there may be some volcanic activity. However, Venus appears to lack any kind of plate tectonics. This may be the result of its lack of water may explain why. On Earth, water helps “soften” or “lubricate” the mantle rocks, enabling them to move. Once any water on Venus boiled away, the tectonics may have shut down completely.

Radar surveys of Venus, have revealed that most of the planet is covered by low, rolling plains, with only about a kilometer of relief in these areas. These plains may be analogous to the low elevation, basaltic sea-floor crust of Earth. Were liquid water possible on Venus, these lowlands might oceans. The other 40% of Venus is covered by highlands, including a few Australia-sized, continent-like plateaus standing a few kilometers above the surface. The largest of these are Ishtar Terra and Aphrodite Terra, named after the Babylonian and Greek goddesses of love and beauty.

These highlands contain a few huge volcanic peaks like Maxwell Montes (the only Venusian feature named after a man). Maxwell towers 10.6 kilometers (35,000 feet) above the average elevation — higher than our Mount Everest rises above sea level.



The terrain on Venus consists of lowlands and several highlands.

https://commons.wikimedia.org/wiki/File:Venus_gif.gif





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